

Improving Campus Security and Efficiency: The RFID-Integrated Monitoring System at Politeknik Mukah Sarawak

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Abstract

This research presents a comprehensive overview of an innovative project aimed at addressing the challenges related to student entry and exit monitoring at Politeknik Mukah, Sarawak. The study reviews the development and implementation of an "Intelligence Data Information System" utilizing advanced RFID (Radio-Frequency Identification) technology to streamline these processes, with the aim of enhancing efficiency, accuracy, and security in monitoring student movements within the campus. The traditional manual methods of monitoring student entry and exit are prone to errors, time-consuming, and often result in inaccurate record-keeping, leading to security vulnerabilities and inefficiencies. Therefore, the primary objectives of this project are to develop and implement an RFID-based monitoring system to automate the recording of student entry and exit, improve the accuracy and reliability of student movement data, and enhance the overall security and efficiency of campus operations related to student monitoring. The Cronbach's Alpha, used to measure reliability, reports a result of 0.936, and the highest mean of 4.7966 indicates that the process of recording students' entry and exit has become more effective, saving students time with a PMU entry and exit mean of 4.8136. To ensure the system's success, it is recommended to integrate this RFID system with existing campus management systems, provide comprehensive training to staff and students, schedule regular maintenance and software updates, and establish a feedback mechanism to gather input for continuous improvement.

Keywords: - Student entry and exit monitoring system, Politeknik Mukah, RFID technology

1. Introduction

This research provides a concise overview of the innovative project idea aimed at addressing issues related to student entry and exit monitoring processes at Politeknik Mukah, Sarawak. This research aims to review of innovation developing a system designed to streamline the process of monitoring student entry and exit within the premises of Politeknik Mukah, utilizing an "Intelligence Data Information System" powered by advanced RFID (Radio-Frequency Identification) technology. With the advancement of technology, we propose to build an "Intelligence Data Information System" to monitor student entry and exit and facilitate the recording process using RFID technology. The traditional manual entry system using logbooks at Politeknik Mukah is inadequate for effective student monitoring. This research proposes the development of a contemporary solution through the implementation of an advanced RFID-based system. RFID technology, widely utilized in various sectors, offers significant advantages in identifying and recording student data accurately and efficiently.

The existing manual methods for tracking attendance and monitoring entry/exit points are inefficient, error-prone, and inadequate for maintaining high security standards. This research identifies the critical need for a more effective and reliable system, proposing the development and

implementation of an RFID-integrated monitoring system to enhance the accuracy, security, and operational efficiency of campus management.

Manual recording of student entries and exits presents several challenges, including inefficiencies, errors, and security risks (Abdul-Rahman et al., 2019). The reliance on manual data entry increases the likelihood of incomplete or inaccurate records, complicating data management and analysis (Mohd-Zamri & Zainal, 2021). Additionally, the absence of real-time monitoring capabilities compromises the institution's ability to promptly track student movements, potentially undermining security measures (Nik-Mustapha et al., 2020). RFID technology has been widely recognized for its effectiveness in improving attendance tracking and enhancing security in educational institutions. Studies have demonstrated significant improvements in administrative efficiency and data accuracy with RFID-based systems (Liu et al., 2018).

The "Intelligence Data Information System" aims to assist PMU students in recording their entry and exit within the premises using advanced technology. The system comprises electronic devices such as PCs, laptops, and mobile phones for displaying the interface and storing student data. RFID readers capture digital data encoded in RFID cards, including student information, which is then recorded in the system.

Fig. 1 illustrates the planning of an "Intelligence Data Information System." This system integrates multiple devices and technologies to collect, process, and utilize data. At the core of the system is the central intelligence data information system which interfaces with various inputs and outputs. It connects to devices such as PCs, laptops, and HP (possibly handheld devices) and integrates with I-CCTV (intelligent CCTV), enabling real-time monitoring and data acquisition. Additionally, the system interacts with RFID card readers that read RFID cards, allowing for automated identification and access control.

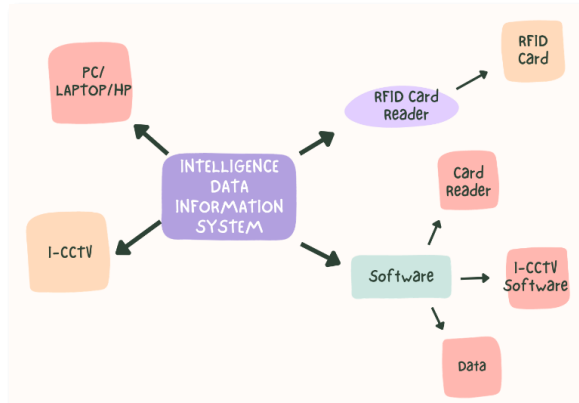


Fig. 1. Intelligence data information system process

Furthermore, the system incorporates specialized software that acts as a bridge between the hardware components and the data processing unit. This software interfaces with card readers and I-CCTV software to ensure seamless data flow and integration. The data collected from these sources is then processed and utilized by the intelligence data information system for various applications, such as security monitoring, access management, and data analysis. This setup highlights the importance of integrating multiple technologies to enhance the efficiency and effectiveness of data management systems.

Wireless systems have been in existence since the 1800s, with early understandings of electromagnetic energy emerging during that period (Landt, 2005). The advent of RFID technology aligns with criteria such as low power consumption, cost-effective production, and touchless functionality. Comprising tags for information storage and readers for data retrieval via radio waves, RFID technology has its roots in James Clerk Maxwell's electromagnetic radiation predictions. Guglielmo Marconi's successful demonstration of radio signal transmission across the Atlantic in 1896 marked a significant milestone in communication history. RFID systems saw initial application around World War II, notably with the British "Identity Friend or Foe" (IFF) system for identifying enemy aircraft, further evolving over the years, and finding continued use in various industries (Roussos, 2008).

The evolution of communication technology has paralleled human civilization's advancement in information dissemination methods, from cave paintings to inscriptions, and eventually, the internet. Samuel Morse's development of the telegraph and Morse code in 1837, alongside Sir William Cook and Sir Charles Wheatstone, represented a significant leap forward. Morse's utilization of simple codes to convey messages via electric pulses through wires, although limited in signal transmission distance initially, paved the way for further advancements (Morse, 2014). The emergence of Information and Communication Technology (ICT), initially intended to be environmentally friendly, inadvertently led to increased paper consumption for rapid printing (Mulder & Peet, 2002). Furthermore, data analysis emerges as a crucial aspect of achieving the industry 4.0 revolution (Matthew, 2014), involving the examination of extensive datasets to derive insights and useful information, enabling users to determine key quality criteria through descriptive data processing, thereby enhancing analysis and decision-making to elevate business service quality. RFID technology has found various applications in the educational sector, including student attendance monitoring systems. Studies have shown the effectiveness of RFID-based solutions in improving attendance tracking and enhancing security measures in educational institutions (Liu et al., 2018). For instance, research by Sarker et al. (2017) demonstrated the successful implementation of an RFID-based student attendance system in a university setting, which significantly reduced administrative workload and improved accuracy compared to traditional manual methods. Similarly, a study by Aljaafreh (2021) explored the use of RFID technology in monitoring student attendance in schools, highlighting its ability to provide real-time data and facilitate timely intervention in cases of absenteeism. These findings underscore the potential of RFID technology to address the challenges associated with manual attendance tracking systems and enhance overall efficiency in educational institutions.

2. Methodology

The "Intelligence Data Information System" facilitates PMU students in recording entry and exit data efficiently. Students only need to scan their RFID cards on the RFID reader, and data such as name, matrix number, date, and time of entry and exit will be recorded in the system. Thus, students do not need to spend 1-2 minutes manually recording in a logbook. Additionally, using this system, entry and exit data can be stored digitally, reducing the risk of data loss compared to logbook records. This system also facilitates PMU staff in accessing the system to monitor student entry and exit, saving time for both students and staff. Project design refers to the systematic creation of ideas involving innovation,

which entails producing or improving existing products or services towards betterment, and creativity, which is the thought process driving the realization of new ideas or discoveries towards a more realistic approach. The process of using this system involves several steps to ensure effective monitoring and management (see Fig. 2).

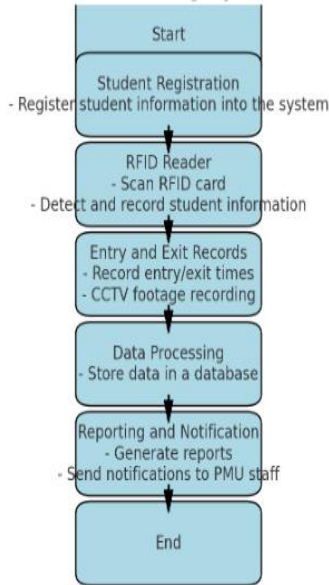


Fig. 2. RFID student monitoring system flowchart

Fig. 2 shows the RFID Student Monitoring System Flowchart illustrates a comprehensive process for tracking students using RFID technology. It begins with the registration of student information into the system, followed by the use of an RFID reader to scan student RFID cards, detecting and recording their information. The system then logs entry and exit times while capturing CCTV footage for visual records. This data is processed and stored in a database, enabling the generation of reports and the sending of notifications to PMU staff about student activities. The process ensures accurate monitoring and efficient communication, enhancing student management and security.

A Likert scale was used for respondents to show their level of agreement with each statement. We used the Krejci and Morgan table to decide the optimum sample size, considering the population size and desired accuracy level. The minimum sample size for this study, according to the Krejci and Morgan method, is fifty-nine participants. However, we opted for a larger sample size of sixty individuals to ensure statistical power and enhance the accuracy of the study's results. The system we are developing, the "Intelligence Data Information System," aims to facilitate students in recording entry and exit data at the main gate entrance of PMU. It is hoped that this system can be efficiently used by students without relying on manual methods, such as writing data in provided logbooks. Therefore, with this system, which

is both easy and fast, paper usage can be reduced, and time can be saved. Furthermore, this system can facilitate PMU staff in accessing the system and monitoring student entry and exit effectively.

3. Results

This section explains the data analysis obtained from the study or research. After the successful implementation of the student entry and exit recording system at PMU and the distribution of a questionnaire using Google Forms involving 59 final semester Diploma in Business Studies students, including 30 students from class DPM5A and 29 students from class DPM5B, the aim of this study is to examine the effectiveness of the student entry and exit system at PMU. The questionnaire covered aspects such as whether the system facilitates the process of recording student entry and exit and whether it improves the efficiency of PMU student entry and exit processes. The data obtained from this questionnaire was then analysed using the Statistical Package for the Social Sciences (SPSS) Version 26.0. This software was used to conduct statistical analysis to measure the effectiveness of the study's findings in more detail based on the collected information. This analysis contributes to understanding the overall study and offers a more detailed insight into the research under consideration. Reliability analysis is a method to figure out the accuracy and stability of a measuring instrument or survey questions. Cronbach's Alpha is one approach to measure reliability, and the reported result $\alpha=0.936$. In this case, a high alpha value indicates that the measurement instrument is stable.

Table 1 shows the identified religions, including Islam, Christianity, and Bahai, among the respondents. The analysis indicates that 37.3% of the total respondents adhere to Islam, while the majority, comprising 59.3%, adhere to Christianity. Bahai followers contribute 3.4% of the total respondents. From the total, the Iban ethnicity dominates with 50.8%, followed by Melanau with 23.7%, and Malay with 16.9%. However, there are smaller ethnicities such as Dusun, Chinese, Lung Bawang, and Kenyah, each contributing only one to two percent of the total.

Table 1. Respondent profile

	Frequency	Percent
Religion		
Islam	22	37.3
Kristian	35	59.3
Bahai	2	3.4
Total	59	100
Race		
Dusun	1	1.7
Iban	30	50.8
Melanau	14	23.7
Cina	2	3.4
Lung Bawang	1	1.7
Kenyah	1	1.7
Malay	10	16.9
Total	59	100.0

Table 2 provides data analysis on the effectiveness of the student entry and exit recording process at PMU. In this context, five questions or studies were evaluated by respondents, labelled A1 to A5. The analysis indicates very high effectiveness in the student entry and exit recording process at PMU. Detailed analysis reveals high average scores for all questions or study items, ranging from 4.6610 to 4.7966, with a total average score of 4.7288, indicating very high satisfaction among respondents regarding the student entry and exit recording process.

Table 2. Facilitation of student entry and exit recording

Item	N	Mean Statistic	Mean Score
1. The process of recording students' entry and exit becomes easier. (A1)	59	4.7627	Very High
2. The process of recording students' entry and exit becomes more effective. (A2)	59	4.7966	Very High
3. The process of recording the entry and exit of students becomes faster. (A3)	59	4.7288	Very High
4. The use of ICCTV can prevent the misuse of PMU students' access. (A4)	59	4.6949	Very High
5. The system displays complete student information. (A5)	59	4.6610	Very High

Table 3 presents an analysis of the effectiveness of the system in improving the efficiency of PMU student entry and exit processes using average statistics and average scores for each study item. In this context, five questions or studies were evaluated by respondents, labelled B1 to B5. The analysis indicates very high scores for all study items in demonstrating the effectiveness of improving the efficiency of PMU student entry and exit processes. Detailed analysis reveals high average scores for all questions or study items, ranging from 4.7288 to 4.8136, with a total average score of 4.76272, indicating very high satisfaction among respondents regarding the effectiveness of improving the efficiency of PMU student entry and exit processes.

Table 3. Improvement in the efficiency of PMU student entry and exit processes

Item	N	Mean Statistic	Mean Score
1. This system facilitates the process of entering and exiting PMU students. (B1)	59	4.7458	Very High
2. This system is faster to record the entry and exit of PMU students. (B2)	59	4.7288	Very High
3. This system saves students time in recording PMU entry and exit. (B3)	59	4.8136	Very High
4. This system can ensure that the actual individual for access in and out of the PMU. (B4)	59	4.7966	Very High

5. This system effectively in recording the entry and exit of PMU students. (B5)	59	4.7288	Very High
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4. Conclusions

The implementation of the "Intelligence Data Information System" using RFID technology at Politeknik Mukah, Sarawak, has proven to be highly effective in addressing the inefficiencies and challenges associated with the traditional manual entry and exit recording processes. This study, involving 59 final semester Diploma in Business Studies students, revealed significant improvements in the facilitation and efficiency of student entry and exit recording. The data analysis, conducted using SPSS Version 26.0, demonstrated high reliability, with a Cronbach's Alpha of 0.936, indicating the stability and accuracy of the measurement instruments. The demographic analysis showed a diverse respondent profile, with a majority adhering to Christianity (59.3%) and a significant representation from the Iban ethnicity (50.8%).

The effectiveness of the student entry and exit recording process was reflected in the very high mean scores across all evaluated items (A1 to A5), with a total average score of 4.7288. Similarly, the system's impact on improving the efficiency of these processes was confirmed by very high mean scores for all evaluated items (B1 to B5), with a total average score of 4.76272. These results underscore the system's ability to significantly enhance operational efficiency and user satisfaction. The findings align with previous research highlighting the benefits of RFID technology in educational settings, where it improves administrative efficiency and data accuracy (Aljaafreh, 2021; Liu et al., 2018). The shift from manual to automated recording methods not only reduces administrative workload but also enhances the institution's capability to maintain high security standards and real-time monitoring.

Based on the study's findings, several recommendations can be made to further enhance the effectiveness and efficiency of the student entry and exit monitoring system at PMU include expand RFID Coverage: To maximize the benefits of the "Intelligence Data Information System," it is recommended to extend the RFID coverage to additional critical areas within the PMU campus. Expanding the system to include entrances of libraries, classrooms, laboratories, and other key facilities will ensure comprehensive monitoring of student movements throughout the campus. This expansion would not only enhance security but also provide a more detailed record of student activities, enabling better management of campus resources and facilities.

Integration with Other Systems: Integrating the RFID system with other existing administrative and security systems at PMU is essential for creating a cohesive and efficient campus management

framework. By linking the RFID data with student information systems, attendance records, and security alert systems, PMU can streamline operations and improve data accuracy. This integration would facilitate real-time tracking and reporting, enabling quick responses to security issues and enhancing overall administrative efficiency. Additionally, it would support better coordination among various departments, leading to more effective campus management.

Continuous Training and Support: Providing continuous training and support for both students and staff is crucial to ensure the successful implementation and utilization of the RFID system. Regular workshops, training sessions, and user manuals should be made available to familiarize users with the system's functionalities and troubleshooting procedures. Establishing a dedicated support team to address any technical issues or user queries can significantly enhance the user experience. This ongoing support will not only help in maximizing the system's potential but also ensure that all stakeholders are confident and proficient in using the technology, thereby improving the overall effectiveness of the student entry and exit monitoring process at PMU.

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